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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/603,795	06/26/2003	Vasilis Papavassiliou	D-20792	3468

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EXAMINER	
LEUNG, JENNIFER A	
ART UNIT	**PAPER NUMBER**
1764	

DATE MAILED: 07/03/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/603,795	PAPAVASSILIOU ET AL.	
	Examiner	Art Unit	
	Jennifer A. Leung	1764	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *24 April 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-15* is/are pending in the application.

4a) Of the above claim(s) *11-15* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-5 and 7-10* is/are rejected.

7)☒ Claim(s) *6* is/are objected to.

8)☒ Claim(s) *1-15* are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *26 June 2003* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *6-26-03*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Applicant's election with traverse of Group I, claims 1-10, in the reply filed on April 24, 2006 is acknowledged. The traversal is on the ground(s) that, "the method would be carried out by an apparatus of the invention and as such would not imposed an undue burden on the office with respect to any further search." This is not found persuasive for the same reasons set forth in the restriction requirement. The fact that the apparatus and the method are separately classified shows that separate searches are required for each of inventions, which imposes an undue burden on the Examiner. The requirement is still deemed proper and is therefore made FINAL.

2. Claims 11-15 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to a nonelected invention, there being no allowable generic or linking claim.

Drawings

3. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they do not include the following reference sign(s) mentioned in the description: "outer oxygen passage **12**" (see specification, section [0023]). Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

4. The informal drawings are of sufficient quality to permit examination. However,

replacement drawing sheets in compliance with 37 CFR 1.121(d) are now required in reply to this Office action. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5. Claims 1, 3, 4, 7, 9 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Burch et al. (US 2004/0154222) in view of Abe et al. (US 6,576,203).

Regarding claim 1, Burch et al. (FIG. 2) discloses an autothermal reactor **70** comprising: a mixing chamber **80** having an orifice (i.e., of distribution device **76**) to expand an oxygen containing stream (i.e., supplied at pipe **74**) into said mixing chamber, and an inlet (i.e., at the end of fuel injector **72**) located adjacent to said orifice and oriented to introduce a hydrocarbon containing stream into the mixing chamber **80** tangentially to the oxygen

containing stream;

an initial partial oxidation reaction zone (i.e., an electrically heated catalyst **84**) having a supported partial oxidation catalyst (e.g., a platinum catalyst; section [0028]) in communication with the mixing chamber **80** and followed by at least two endothermic reforming reaction zones (i.e., catalyst regions **90** and **92**; sections [0033], [0034]); and the at least two endothermic reforming reaction zones **90,92** containing a precious metal catalyst supported on supports (e.g., a suitable catalyst such as a platinum-rhodium catalyst mounted on a suitable substrate or monolith for region **90**; also, catalyst similar to the light-off catalyst or a steam reforming catalyst in region **92**; see sections [0033], [0034]). Burch et al. is silent as to the supports being formed of materials that provide a greater surface area for a successive of the reaction zones **92** than an initial of the reaction zones **90** directly following the partial oxidation reaction zone **84**, wherein the initial and the successive reaction zones **90** and **92** are configured to operate at ever decreasing operational temperatures such that a material making up a support of the successive reaction zone **92** remains stable.

Abe et al. (FIG. 1) teaches a reactor comprising an initial reaction zone (i.e., upstream catalyst **1**) and a successive reaction zone (i.e., downstream catalyst **2**), wherein a support of zone **1** is formed of a material providing a greater surface area than a support of zone **2**, and zone **1** is configured to operate at ever decreasing operation temperatures such that a material making up the support of zone **2** remains stable (i.e., the supports satisfy criteria (1), (2), (3) and/or (4) with respect to cell density and/or heat capacity of the support material; see column 4, line 60 to column 6, line 65).

It would have been obvious for one of ordinary skill in the art at the time the invention was made to configure the supports for reaction zones **90** and **92** as claimed in the apparatus of

Burch et al., because the claimed configuration leads to improvement of reformer safety, heating characteristic during the start-up period, efficiency of hydrogen production and reduction in production of CO as the co-product, as taught by Abe et al. (see Abstract; column 4, lines 33-59).

Regarding claim 3, Burch et al. discloses that the partial oxidation zone **84** is formed by a monolithic support (see section [0028]). Burch et al. further discloses,

> "The-light off catalyst region **90** includes a suitable catalyst, such as a platinum-rhodium catalyst, mounted on a suitable substrate or monolith depending on the application requirements. Foams or other structures can also be used that induce gas-to-catalyst surface interaction and provide reaction stability." (section [0033]).
>
> "In one embodiment, the main catalyst region **92** includes a 600 cells per square inch (CPSI) parallel channel monolith made of cordierite having a similar catalyst as the light-off catalyst. The main catalyst could be made of other materials and geometric configurations, as would be well understood to those skilled in the art." (section [0034]).

Although Burch et al. is silent as to reaction zones **90** and **92** each being formed, specifically, as a bed of pellets, it would have been obvious for one of ordinary skill in the art at the time the invention was made to configured each of the reaction zones **90** and **92** in the modified apparatus of Burch et al. as a bed of pellets, on the basis of suitability for the intended use and absent showing any unexpected results thereof, because the Examiner takes Official Notice that the provision of catalysts in the form of a fixed bed of pellets for inducing gas-to-catalyst surface interaction and providing reaction stability is well known in the art of catalysis. Furthermore, the substitution of known equivalent structures (e.g., the substitution particulate catalyst for monolithic catalyst, and vice versa) merely involves routine skill in the art. *In re Fout* 213 USPQ 532 (CCPA 1982); *In re Susi* 169 USPQ 423 (CCPA 1971); *In re Siebentritt* 152 USPQ 618 (CCPA 1967); *In re Ruff* 118 USPQ 343 (CCPA 1958).

Regarding claim 4, a ceramic heat shield of honeycomb configuration (i.e., a substrate **86**, made of various material such as ceramic, and in the form of a honeycomb structure; see section [0032]) is located between the partial oxidation reaction zone **84** and the mixing chamber **80**.

Regarding claim 7, the mixing chamber **80**, the partial oxidation reaction zone **84**, and the endothermic reaction zones **90** and **92** are in an inline relationship (see FIG. 2).

Regarding claim 9, the precious metal catalyst may comprise Pt or Rh (see sections 0028], [0033] and [0034]).

Regarding claim 10, the monolithic support **84** is doped with a partial oxidation catalyst (i.e., a substrate or monolith catalyzed with platinum; see section [0028]). Although Burch et al. is silent as to the support **84** material being ceramic, it would have been obvious for one of ordinary skill in the art at the time the invention was made to select ceramic as the material for forming support **84** in the modified apparatus of Burch et al., on the basis of suitability for the intended use and absent showing any unexpected results thereof, because the Examiner takes Official Notice that the use of ceramic material for forming monolithic catalyst supports is well known in the art of catalysis.

6. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Burch et al. (US 2004/0154222) in view of Abe et al. (US 6,576,203), as applied to claim 1 above, and further in view of Sederquist (US 4,381,187)

Burch et al. is silent as to the mixing chamber **80** defining an inner surface outwardly diverging from said orifice to form a frustum of a cone, wherein the angle of divergence is calculated to inhibit recirculation within the mixing chamber. Sederquist (FIG. 1; column 6, lines 46-68; column 7, lines 44-61) teaches a mixing chamber **18** defining an inner surface (i.e., defined by conical upstream diffuser **14**) outwardly diverging from the orifice **22** to form a

frustum of a cone. It would have been obvious for one of ordinary skill in the art at the time the invention was made to substitute the mixing chamber shape as taught by Sederquist for the mixing chamber **80** shape in the modified apparatus of Burch et al., on the basis of suitability for the intended use and absent showing any unexpected results thereof, because the mixing chamber shape taught by Sederquist allows for sufficient vaporization and mixing of the hydrocarbon and oxygen containing streams. The angle of divergence for the inner surface of the mixing chamber does not confer further patentability to the claim because the specific angle of divergence would have been considered a result effective variable by one having ordinary skill in the art. Accordingly, one of ordinary skill in the art would have routinely optimized the angle of the inner wall of the mixing chamber to obtain the desired vaporization and mixing characteristics for the hydrocarbon and oxygen containing streams, *In re Boesch*, 617 F.2d. 272, 205 USPQ 215 (CCPA 1980), and where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art, *In re Aller*, 105 USPQ 233.

7. Claims 5 and 8 rejected under 35 U.S.C. 103(a) as being unpatentable over Burch et al. (US 2004/0154222) in view of Abe et al. (US 6,576,203), as applied to claims 1 and 3 above, and further in view of Sonetaka et al. (US 4,211,672).

Abe et al. teaches that the initial reaction zone (i.e., upstream catalyst) should have a cell density that is less than the cell density of the successive reaction zone (i.e., downstream catalyst). Thus, the initial reaction zone inherently comprises a specific surface area that is less than the specific surface area of the successive reaction zone (see column 5, lines 33-63). Although the collective teachings of Burch and Abe are silent as to the specifically claimed configuration of selecting alpha-alumina as the support material in the initial reaction zone **90**

and gamma-alumina as the support material for the successive reaction zone **92**, and although the collective teachings of Burch et al. and Abe et al. are further silent as to the specifically claimed configuration of selecting a surface area from between 0.1 and about 10 m^2/gm for the initial reaction zone **90** and a surface area between about 5 and about 300 m^2/gm for the successive reaction zone **92**, it would have been obvious for one of ordinary skill in the art at the time the invention was made to select the claimed configurations for each of the reaction zones **90** and **92** in the modified apparatus of Burch et al., on the basis of suitability for the intended use and absent showing any unexpected results thereof, because it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art, *In re Aller*, 105 USPQ 233. Furthermore, the use of alpha-alumina and gamma-alumina as catalyst support materials is well known in the art of catalysis. Sonetaka et al. further evidences that it is well known in the art that conventional alpha-alumina catalyst carriers have a smaller surface area than conventional gamma-alumina catalyst carriers (see column 8, lines 10-23). The conventional alpha-alumina carriers typically comprise a surface area in the range of from 5 to 15 m^2/gm, whereas the conventional gamma-alumina carriers typically comprise a surface area in the range of from 100 to 300 m^2/gm.

Allowable Subject Matter

8. Claim 6 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. The prior art does not disclose or adequately teach the apparatus as claims in claims 1-3, further comprising a secondary mixing chamber situated between the partial oxidation reaction zone and the at least two endothermic reforming zones, wherein the secondary mixing zone comprises a secondary inlet to receive a recycle stream containing

synthesis gas components obtained by separation of hydrogen and carbon monoxide from said synthesis gas.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jennifer A. Leung whose telephone number is (571) 272-1449. The examiner can normally be reached on Monday through Friday, 9:30 AM to 5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Glenn A. Caldarola can be reached on (571) 272-1444. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Jennifer A. Leung
June 25, 2006

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